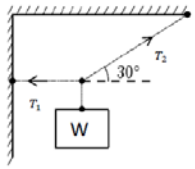
Ayman Ghannam
Chapter 12
Equilibrium



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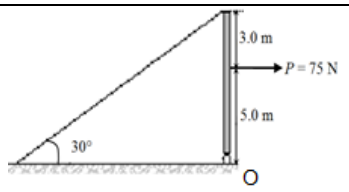

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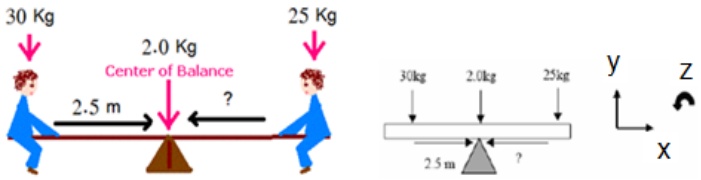

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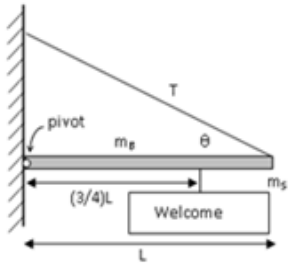
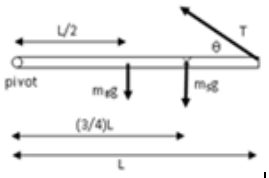
Q.1 A weight W = 100 N is hung from two ropes as shown in the figure. Find the magnitude of the tension in the horizontal rope. ($T_2 = 200$ N, $T_1 = 173$ N)

Q.2 A uniform 100 kg beam is held in a vertical position by a pin at its lower end, a cable at its upper end, and by applying a horizontal force *P* = 75 N as shown in **Figure**. Find the tension in the cable.(T=54.31N)

Q.3 Consider a playground seesaw. The mass of the plank is 2.0 kg, the masses of two children on it are 25 kg and 30 kg with the 30 kg child sitting 2.5 meters from the center of the plank as shown. Where must the second child sit in order for this system to be in equilibrium? (x = 3 m)





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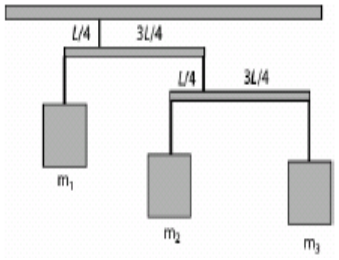

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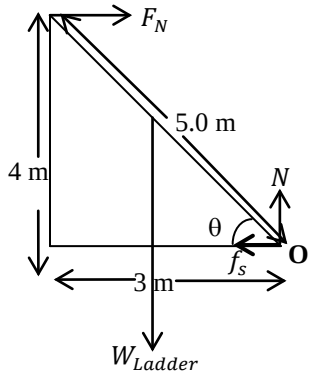

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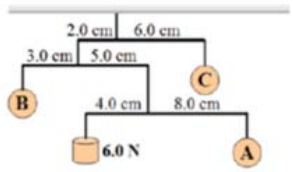
Q.4 A store welcome's sign with mass m_S is hung from a uniform bar of mass m_B and length L. The sign is suspended from a point ¾ of the way from the wall. The bar is held up with a cable at an angle θ as shown.

a- Calculate the tension T in the cable.

b- If the wall is exerting some force $\vec{F}_W$ on the left end of the bar. What are the components F_{wx} and F_{wy} of this force?

Q.5 The Figure shows a three boxes of masses m_1, m_2 and m_3 hanging from a ceiling. The crossbars are horizontal and have negligible mass and same length *L*. If m_3 = 1.0 kg, then m_1 is equal to m_1=12kg)

Q.6 A uniform ladder whose length is 5.0 m and whose weight is 4.0×10^2 N leans against a frictionless vertical wall. The foot of the ladder can be placed at a maximum distance of 3.0 m from the base of the wall on the floor without the ladder slipping. Determine the coefficient of static friction between the foot of the ladder and the floor.($\mu_s = 0.38$)



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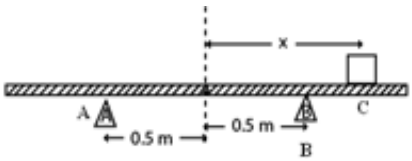

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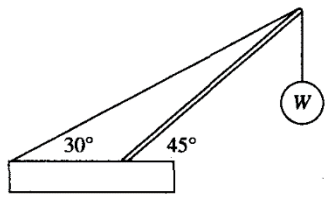
Q.7 Consider the assembly shown in **Figure**, where four objects are held in equilibrium by horizontal massless rods. What is the weight of ball C?(A=3N, B=15N and C=5N)

Q.8 A uniform rigid rod having a mass of 50 kg and a length of 2.0 m rests on two supports A and B as shown in the Figure. When a block of mass 60 kg is kept at point C at a distance of *x* from the center, the rod is about to be lifted from A The value of *x* is: (x=0.9m)

Q.9 To know the location of the CM of a person, one has to use the arrangement shown in figure. A plank of weight 40 N is placed on two scales separated by 2.0 m. A person lies on the plank and the right scale reads 314 N and the left scale reads 216 N. What is the distance from the right scale to the person's CM? (x = 0.80 m)

Q.10 In the crane here the boom is 3.2 m long and weighs 1200 N. The cable can support a tension of 10,000 N. The weight is attached 0.5 m from the end of the boom. What maximum weight can be lifted?



Q.11 On suspending a weight *Mg*, the length *L* of elastic wire and area of cross-section *A* its length becomes double the initial length. Calculate the stress on the wire. $\frac{2Mg}{A}$

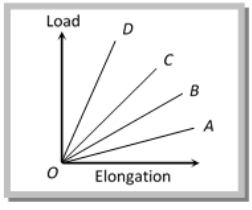
Q.12 The length of a wire increases by 1% by a load of 2.0 N. Calculate the linear strain produced in the wire.0.01

Q.13 The diameter of a brass rod is 4 *mm* and Young's modulus of brass is $9\times10^{10}\ N/m^2$. The force required to stretch by 0.1% of its length.(360Pi)

Q.14 A wire of length 2.0 m is made from 10 cm^3 of copper. A force *F* is applied so that its length increases by 2.0 mm. Another wire of length 8.0 m is made from the same volume of copper. If the force *F* is applied to it, its length will increase by (3.2cm)

Q.15 A solid copper cube has an edge length of 85.5 cm. How much hydraulic stress must be applied to the cube to reduce the edge length to 85.0 cm? The bulk modulus of copper is 1.40×10^{11} N/m^2.2.44×10^9N/m^2

Q.16 The load versus elongation graph for four wires of the same material is shown in the figure. The thickest wire is represented by the line.(a)*OD*



Q.17 The Young's modulus of a wire of length *L* and radius *r* is *Y* N/m^2. If the length and radius are reduced to *L*/2 and *r*/2, then its Young's modulus will be

Q.18 A <u>fixed</u> volume of iron is drawn into a wire of length *L*. The <u>extension</u> *x* produced in this wire by a constant force *F* is proportional to $\Delta L \propto L^2$